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ABSTRACT

This booklet is intended as a reference on the application of the technology of communication systems to distance education. An introductory section addresses the nature of the interaction imposed by use of various technologies. The next section overviews current telecommunications applications based on these major technologies: radio, television (closed circuit television, cable television, instructional television fixed service, slow scan television, broadcast television, teletext, viewdata, telidon), and telephone (interactive teaching, telephone links to data systems). Two stand-alone systems, which may have outstanding applicability to distance education, are then briefly mentioned--the intelligent video disc and the Open University's Cyclops System. The final section addresses terrestrial telecommunications in the Australian context with projections for 1990. A list of possible applications is provided. (YLB)

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TERRESTRIAL COMMUNICATIONS SYSTEMS IN DISTANCE EDUCATION

Ross Worthington

A REFERENCE BOOKLET PREPARED FOR A CONFERENCE ON TELECOMMUNICATIONS APPLICATIONS TO DISTANCE TEACHING AT THE DARLING DOWNS INSTITUTE OF ADVANCED EDUCATION, QUEENSLAND, AUSTRALIA.

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

INTRODUCTION

Communications technology is the core of the distance teaching enterprise. Traditionally, based upon print technology, distance education systems have, since the mid 1960's, become increasingly aware of the potential educational value of audio-visual and telecommunications technologies. Moore recognises this technological base by describing the communications pattern in distance teaching between teacher and learner as essentially *"facilitated by print, electronic, mechanical or other devices"*. [1]

Peters interpretes the central role of communications technology in distance teaching as totally dominating the methodology; *"Correspondence instruction is the most industrialized form of instruction .."*. [2]

The operational interdependence of this teaching mode and communications technology has led to distance education systems working at the forefront of technological applications to education, in order to expand its market, humanize its methodology and stretch existing funds to encompass continuing demands for education services. [3] Recent technologies offer education systems relatively easy access to untapped markets and the chance to expand the services offered to current clientele who may be limited in the number and quality of services available to them.

Within Australia, and Queensland in particular, interest has recently centred on the possible educational applications of the Australian Domestic Satellite System (ADSS). This system should be operational between 1985 - 1987, and will be complemented by a terrestrial telecommunications network which, by 1990 should service facilities to all but 0.3 per cent of the nation's population. In addition to these advances in the telecommunications sector, significant progress has been achieved in the audio/visual communication area. Both these aspects of communications technology will be discussed in this paper.

Before progressing I would like to reiterate a warning I have made before concerning adoption of new technologies to distance teaching. [4] Too often educators see new technologies as 'magic lantern' solutions to educational problems. To the distance educator, tied to what is commonly perceived as the monotony of the printed word, new technologies hint of forbidden fruit;

forbidden in that the costs of the systems are frequently high compared to print, and fruitful in the educative benefits which can be derived from their use. Enthusiasm for new systems is usually warranted. However it must be tempered by a careful examination of the technological alternatives, and decisions made in the light of informed evaluations of these alternatives. I have no doubt whatsoever that the ADSS has immense educational potential; however decisions on the use of any system cannot be adequately reached without consideration of the existing communications environment.

Concentration solely upon the technical capacities and use patterns of new technologies can also be an unrewarding orientation if it is to dominate educational consideration of these technologies. Both technological and pedagogical issues must be examined. The basic approach of educators to suitable technologies should be the exploitation of those technologies to achieve educational goals which other methods or technologies cannot achieve, or achieve as efficiently. Fortunately the tendency to see technology alone as the answer to educational problems has become less dominant in recent years. [5]

Technology as part of complex and interdependent educative settings has become, appropriately, one of a number of components of solutions; not <u>the</u> solution.

MAN-MACHINE INTERACTION

In considering educational applications of technology it is essential that the behaviour settings of the educational experiences be considered. Communication systems have the capacity to impinge both actively and passively upon a student's learning setting. The following continuum has been suggested as depicting the interactive continuum within the distance students learning environment.[6]

Non-Interactive	
Simulated Interaction	Technological Interactions
Delayed Interaction	
Mediated Interaction	
Unmediated Interaction	Face-to-Face

The nature of the interaction imposed by use of various technologies is an important consideration in their use, value and effectiveness with regard to the students using them. The continuum outlined above may be better explicated by example. Typical technologies and their interactive settings are shown below.

Non-Interactive: broadcast radio, audio-tape.
Simulated Interaction: intelligent video-disc, CAI, programmed learning materials.
Delayed Interactions: communication by mail.
Mediated Interaction: person to person interaction via telecommunications technologies such as the telephone.
Unmediated Interaction: face to face interaction.

CURRENT TELECOMMUNICATIONS APPLICATIONS

Current telecommunications applications to teaching at a distance may be described, albeit rather crudely, as based on the exploitation of four major technologies; radio, television, telephone and magnetic tape for audio or video use. The number and types of adaptations made to enable a range of teaching activities to take place using these technologies is enormous. In this section I will attempt to provide an overview of the major systems developed over the past 30 years using these technologies, and give a brief introduction to recent developments in other areas.

RADIO

Radio has been used as an educational tool, in the broadcast mode, since at least 1937, [7] and continues to be used predominantly in this way. Almost every industrialized nation uses broadcast radio as an adjuct to regular educational programs. Many developing nations also use broadcast radio. However in these situations it is used as either a core component in the teaching process [8] or for community/rural development as in Kenya, [9] Ghana, Tanzania and India. [10] In specific reference to distance education radio appears to be still used primarily in the broadcast mode, particularly in the British [11] and German Open Universities, in the United States [12] and in Japan [13]. The only programs which appear to use interactive radio as a regular part of their teaching are the Australian Schools of the Air at primary level, and the University of the South Pacific in undergraduate courses. [14] Several problems are associated with the use of radio, both for broadcast and for interactive teaching. A series of studies on the radio component of teaching courses at the British Open University [15] have pinpointed a number of problems with the medium as a teaching tool in distance education. These studies found that:

students preferred radio/vision to radio;
few students used broadcasts to pace their studies;
radio was the first component omitted when a student was pressed for study time;
the use of audio/visual channels combined was superior to radio plus written notes.

The Open University also has one other major problem; it has run out of time for programming radio programs; its radio network is used to capacity.

We are also moving into an increasingly active sunspot cycle which will play havoc to a greater degree with HF transmission.

While HF radio has been a success over the last 20 years with Australia's Schools of the Air, one must admit that it is success qualified by economics and technological development and expansion. Alternatives for interactive teaching should be seriously looked at to build on the foundations established by HF radio.

TELEVISION

Television under the titles ITV and ETV has had a more rapid penetration into the educational market than radio. Within a few years of the widescale introduction of television to the United States, large district wide educational television components were being established.[21] Several types of television transmission have been developed to provide a range of services; closed-circuit; cable; Instructional Television Fixed Service (ITFS); slow scan television, program delivery by videotape, as well as broadcast television. Very few of these systems have been developed to provide educational services to distant learners, although all could be used to do so. A brief outline of each of these systems is provided to demonstrate their capabilities and current usage.

CLOSED CIRCUIT TELEVISION

In recent years closed circuit television has been defined as any television system which controls the originating and viewing function within a small closed system such as a local school or classroom. Under this definition video cassettes and in house transmission by cable within a school are included. Almost every school, college and university in the industrialized nations would have a closed circuit television system under this definition, as would many members of the general population.

CABLE TELEVISION

A television system relayed to subscribers through underground cable either directly from the signal originator, or via a microwave link is termed cable television or CATV (Community Aerial Television). Cable television was initiated in rural Appalachia in 1949 to improve reception in the mountainous region, and quickly spread through the United States, Canada and Europe. The diagram below illustrates how cable television systems operate. A separate cable, with approximately one thousand times the information - carrying capacity of a telephone cable, is laid into all homes on a particular route; the one cable services all subscribers on that route, as opposed to individual wiring for telephone services to each home. This *'common source'* of signals in CATV is the principal reason for it being

comparatively inexpensive compared to telephone wiring. In the United States there are 700 - 1000 cable television stations servicing roughly 13% of the population. [22] Until 1972, in the United States, all such CATV services were one-way, or broadcast, only. In 1972 however, the Federal Communications Commission (FCC) decided that CATV systems should be constructed with a reverse channel capability to develop interactive CATV systems. [23] Such a capability allows a wide range of services to be offered over the cable; user initiated access to special programs, systems, information banks, computer programs, interactive study, library searching. Warner Brothers have already developed and marketed a cable system with limited interactive capacity titled the QUBE system, within the United States.

INSTRUCTIONAL TELEVISION FIXED SERVICE

Within the United States several school districts and state education systems including colleges and universities have established educational telecommunications systems with a large television component which serve a wide area and a large number of institutions. These systems use microwave transmission links to overcome topographical characteristics hostile to cable links, and have become known as Instructional Television Fixed Services (ITFS). Several examples abound. In Appalachian Maryland an ITFS system is hooked into a cable television system to provide general telecommunications and educational services to local schools, colleges, police, fire, community health and municipal organizations. [24] In New York State one 26 school local school district owns and operates a small microwave system with a four channel capacity to transmit programs to all its schools. [25] A similar system is also used in one large rural/urban district near Palm Beach Florida. [26] Colorado State University is linked to three Junior State Colleges by a slow scan television network used for telelectures supplemented by electro writers for graphics transmission. [27] According to Hitchins, in 1977 there were approximately 500 ITFS systems operated by 99 licensees, in the United States. [28]

SLOW SCAN TELEVISION

Slow scan television (SSTV) is the transmission of still graphics over a much narrower band width than conventional television. True moving graphics are not possible with slow scan television, but still pictures of diagrams,

pictures, printed documents and other still graphics is possible. The band width of this medium is 2500 - 3500 Hz, compared to 4.6 MHz for normal real-time television. This means that SSTV can be transmitted over one telephone or radio channel compared to 600 - 1000 channels for normal television. This restriction on band width is responsible for the limited scanning rate and hence, name of the medium; 128 scan lines at a rate of 15 lines per second. Normal television operates at 525 scan lines at 15,750 lines per second (U.S.A.). The equipment required for SSTV transmission is minimal and inexpensive. The images are generated by an SSTV camera, converted into audio tones and transmitted. These audio tones can be recorded on a standard audio tape and played back if required. Within its limitations SSTV has been a helpful support system for interactive audio-conferencing. [29] The University of Colorado uses this system for undergraduate teaching between colleges as already mentioned. [30] SSTV can be transmitted over the HF frequencies currently used by the Schools of the Air, or through reserved telephone channels in an interactive teaching network. There appears to be little current use of this technology in either general or educational fields.

BROADCAST TELEVISION

Television transmitted atmospherically is termed broadcast television. Reception and utilization is of no cost to the consumer and available to all who own a television which can receive transmissions on the relative frequencies. These systems are common in many nations and in areas where the terrain permits are the cheapest form of providing television services to a mass audience, with one exception. Satellite provision of television is less expensive over a wide area than the development of new terrestrial networks over a similar area. [31] Almost every nation which has a television system has included an educational component within it. Some systems are set up for purely educational purposes such as Tele-Niger [32], regional systems in the United States [33], the Mexican Telesecundaria [34], the Japanese NKI University of the Air, [35] the Ontario Educational Communications Authority network in Canada [36] and several European networks [37]. Because almost all students in industrialized countries have access to a television receiver free of charge (after the initial purchase cost, usually for entertainment) broadcast television has become extremely popular as a teaching medium in distance education. The Chicago TV College has been offering telecourses since 1965. [38] Similar use of television has been made

by the University of Mid-America, a regional consortium of universities, [39] the British Open University, [40] several United States Universities, [41] France and Germany, [42] by the Institute Nacional de Teleducation in Peru, [43] and for higher technical education in Poland. [44]

Many of the problems which beset broadcast radio are found in the use of broadcast television when used as a teaching resource in distance education. Assumptions must be made about learning sequence and pace; students have no control of the program, and a reservoir concept of knowledge appears to underly programming design. While broadcast television may be a good motivator and has the capacity for conceptual clarification of issues and promoting realism in topics being studied, some studies have found that students do not find it of great help [45] and that learning outcomes from using television are not significantly better than learning without television. [46] In general the literature on the effectiveness of television for instruction is contradictory, [47] and there is an obvious need for more research into the pedagogical issues of instructional television. In particular issues in content limitations (what can't be taught by television?), program design and orientation, and the nature of the television component within an integrated curriculum package, require further investigation. Greater consideration should also be placed upon learning theory and the role of visual perceptual responses in learning such as those proposed by Bruner, [48] Piaget and Inhelder, [49] Gagne and Ausubel [50]. In relation to distance teaching the best conclusion which can be made concerning the use of broadcast television is that even if its use does not lead to increased learning, if the medium can build upon its strengths to be used as a knowledge resource and a motivational and conceptual tool it has a valuable role to play in this area.

Two solutions to the many problems of instructional broadcast television are readily available, at a cost. The use of video cassettes to supply programs to students, and the introduction of interactive telecourses and telelectures.

The use of video cassettes to present telelectures enables the student to control the pacing of the presentation and to match this with his own learning style.

Although most students would not have personal video players, most would have access to such equipment at their place of employment, or be able to arrange to use such facilities in schools, hospitals, education centres or government offices, in both rural and urban areas. In the future inexpensive videodisc players will also be available to enable this type of service to be offered at very low cost to originator and user. The potential of such systems will be discussed later in this paper.

Although some efforts have been made to develop simulated interactive formats in television programming, [52] few efforts appear to have been made to produce interactive telecourses. In North Texas a group of colleges uses a telephone audiolink as the interactive component in cable television programs. [53] The best developed example of interactive television teaching at the moment is the Oklahoma Higher Education Televised Instruction System which provides graduate credit courses to 23 locations within the state of Oklahoma. Terrestrial microwave links are utilized as the carrier for this one way video two-way audio system which has been operating since 1971.

The most recent innovation in interactive television has been the introduction of teletext which is available as a limited data display system or as an interactive system with almost limitless possibilities. Before these technologies are discussed I would like to define the terms I use to describe these two systems. Teletext is used to denote a simple data display composed of a number of pages which can be *'turned'* by keying of an electronic control. Viewdata denotes an interactive data base. A generic term, videotex, is slowly being adopted by some standards organizations.

TELETEXT

One of the first teletext systems produced was the BBC's CEEFAX (See - Facts) service, a 200 - 300 page *'magazine'* inserted into the vertical blanking interval in standard television transmission. The data is transmitted in the spare space in the normal television transmission; in fact between successive pictures. From this it may be obvious that the amount of space into which the data fits if finite. Data transmission is also slow; about .25 seconds for a full page of 960 characters (or a simple diagram). The full magazine is continuously transmitted, with a magazine of 100 pages taking roughly 25 seconds to transmit. Each page has a label number, usually of three digits.

The viewer selects a page by using a special keyboard which interacts with a decoder attached to the television set. The decoder selects the data page, places it in memory and displays it continuously until a new page is selected. A typical teletext system is shown in the diagram below.[54] Teletext systems are also operated by the British ITV network (*'Oracle'*); the French broadcasting authority (*Antiope*), Canadian broadcasters (non-interactive *'Telidon'*), in Salt Lake City Utah, and over one major national broadcasting network in Australia (non-interactive *'Telidon'*).

VIEWDATA

Although viewdata displays its final product onto a television screen, the similarities stop there. Where teletex allows access to a few hundred pages at the most, viewdata allows access to as large a data base as you wish, or to several data bases. You can not only access vast amounts of information but you can interact with the data base and also create your own data base. The diagram below outlines the viewdata system. As can be seen, the viewdata system uses the telephone network to establish its interactive link, a facility which allows great versitility in establishing peripheral equipment (fascimile, printers, plotters, micro computers) to interface with the viewdata system, and also allows for accurate costing of use of the service, including control of student access and usage. Telephone and bi-directional cable television are the most economical formats for viewdata systems as traffic flow in both directions is catered for in the one system. A broadcast television/telephone linkup is also a feasible system. In using the viewdata system a more complex keyboard is used to interact with the data base.

Viewdata systems have been developed in Britain (PRESTEL), Germany (BILDSCHIRMTEST), France (ANTIOPE/TITAN), Canada (BELL VISTA; TELIDON), and the United States (THE SOURCE data network; GREENTHUMB BOX, VIEWTRON). In this paper I will limit my discussion to the leading second generation viewdata system; the Telidon system developed by the Canadian Department of Communications,[55] and to limited examples of other emerging second generation systems.

TELIDON

The Telidon system is not an adaptation of such first generation viewdata systems as Prestel, but a new system which is designed to meet specific needs in what is seen as a large but slowly emerging market. Telidon technology aims at providing, along with print displays;

high screen resolution;
full colour capability;
full grey scale capability;
and photographic reproduction. [56]

The British and French systems do not allow for any of these capabilities because of the severe technical limitations, particularly in terms of graphics capability, imposed by their character formating protocols. [57]

The Telidon system comprises four basic elements;

a central computer to store information and distribute it to the user;

a communications link to carry the information between the computer and the subscriber;

an adaptor to translate signals exchanged between the subscriber and the central computer;

a terminal (including keyboard) on which information can be displayed and from which directions can be sent to the computer.

What can a student Telidon user do with this system? The following list outlines some of the possibilities.

Access, study and record from information banks.
Conduct on line library/data base searching; order titles, articles etc.
Carry out administrative procedures at a University or College (e.g. enrolment, payment of fees through Telidon access to banking/credit facilities).

Interact with lecturers, tutors for course work.
Contact other students on Telidon to form mutual support groups.
Type and transmit assignments and retain a record of such.
Sit for tests, examinations.
Carry out CAI lessons and instructional sessions.
Establish his own data bases, create records.
Vote in institutional elections.

Since January, 1980, large scale trialling of the Telidon system has commenced in Canada. The Ontario Educational Communications Authority is using over 50 terminals in its field trials, the Manitoba Telephone System is using 170 terminals in two separate studies, and the Alberta Government Telephone is testing 20 terminals in the Calgary area. In 1981 Bell Canada will do an extensive trialling using 1000 terminals, principally in the Toronto area. Results from the 1980 trials are not expected until 1981. [58]

Viewdata systems obviously have a lot to offer distance education. If one assumes that most students have access to a television set and a telephone, either personally or in the work place, the estimated costs of this system when used on a large scale will permit its development, not only as an education service, but as a community information service. The cost to the user by 1985 is costed roughly at $C200 - $C300 for supply of the translator and keyboard. [59]

Two services in the United States are also of interest; the Source, and the Greenthumb Box.

The Source is a network of data bases which provides low cost access to the home computer user. This network allows access, with the correct interfaces, into a system which enables the user to carry out data searches, access CAI banks, obtain current news and financial information and perform limited business transactions. While this system is not of immediate importance, the concept of a network accessible from home micro computers has a deal of appeal for distance education. The current proliferation of micro computers world wide can be expected to continue as costs fall and computing power increases.

The Greenthumb Box is a specialized, and thus limited example of a viewdata system. Developed by the University of Kentucky in association with the U.S. Department of Agriculture, it is an interactive information system for farmers. A farmer calls the central computer and requests specific information orally from an operator. The information is transmitted through the telephone system and stored in a special decoder/memory (the Greenthumb Box). The farmer then uses his television to replay the information.

Viewdata must be considered as one of the most valuable communications systems to become available to educators, and holds particular interest for off-campus and distance studies. It's introduction to Australia is not planned within the foreseeable future within the general telecommunications network but higher education institutions in particular should note it for possible institutional or private networking development within the next decade.

Consideration of videotex systems raises the possibility of even more complex educational telecommunications system incorporating radio, television, telephone, data and computing facilities. Systems with mixtures of these components have been developed by university systems ir the United States. The Texas Telecomputer Grid, the Nova University Novair system, the TICCIT [60] and PLATO [61] systems are all multiple service systems designed for education. The most outstanding example of an educational telecommunications network in higher education is the Texas Telecomputer Grid.

This system is a microwave link up of computer systems and television systems to provide telephone, instructional television and conferencing facilities to a consortium of colleges throughout Texas. The initial components of the system are shown on the map opposite. The system has since been extended to several other regional centres. Full duplex voice, data and television communications are provided. [62]

TELEPHONE

The telephone network is the most pervasive two way communications network available today. Over the telephone network audio, data, slow scan television and fascimile can be sent. The connection of a telephone cable means connecting you into a powerful system within which you can communicate with other persons individually or in groups simultaneiously, interact with computer systems and data bases, broadcast using slow scan television, and transmit documents. The same cable and microwave system which carries these services can also carry radio and television signals although the television transmission uses a large amount of the band width. As far as educators are concerned a telephone should never be seen as merely a rapid business transaction or a call line to the family; the telephone system is a powerful educational tool which should be exploited, particularly for distance education.

In the past twenty-five years the telephone has developed as a major educational tool for telelectures, student counselling, computer assisted instruction, teleconferencing and individual tutorials. As early as 1958, Stephens College Missouri was using loudspeaking telephones to bring expert lecturers into college courses from distant locations. [63] Since then the telephone network has become widely used in education, particularly higher education, for two major purposes; interactive teaching on a group or individual basis, and to link students into computer and data base networks.

INTERACTIVE TEACHING

The number of institutions using the telephone for interactive teaching, although not large, has grown in recent years. Many trials have been made and abandoned, such as the link between the Universities of Cambridge, Edinburgh, Sheffield and Manchester between 1970 - 72. [64] However many universities, particularly those concerned solely with distance education have retained and in some cases expanded their facilities in this area. Telephone conferencing and tutorials are a regular feature of courses at the University of Kansas, [65] University of Wisconsin - Extension, University of Illinois, University of Missouri, University of Quebec, Chicago T.V. College, [66] Athabasca University (Canada), [67] the German

Telekolleg, [68] the University of South Africa, [69] the University of Lund [70] and University of Linkoping [71] (Sweden), and the British Open University. [72] The most extensive institutional networks are maintained by the University of Wisconsin - Extension; the Educational Telephone Network (ETN) and the Statewide Extension Education Network (SEEN), which offers visual presentation using electrowriters as well as audio. A map of the ETN system, which can also be linked into other telephone networks such as the University of Illinois' Telenet, is shown on the opposite page. In 1975 24,000 students at almost 200 sites participated in 1000 ETN credit and non-credit programs. [73] A number of programs at the pretertiary level also use the telephone to provide educational services to homebound children. [74]

The telephone systems run by these various institutions are not technologically identical. For contrast, the Open University and the University of Wisconsin - Extension provide good examples. The Open University's system is predominantly a one-to-one tutorial between a regional course tutor and a student. Conference calls for groups of up to seven students are used on a limited basis by regional tutors. According to Turok, the Open University is the only institution which currently uses conference calls as a regular part of their teaching program. [75] The University of Wisconsin ETN system is a party line network. Although students can talk to the lecturer, with the typicaliy large groups in the system (up to 4,000 for one lecture), the degree of interaction is limited. However this system is flexible and very cost effective. It does not allow for one-to-one tutorials or usually for such small conference tutorials as operated by the Open University. [76]

No evaluations of the ETN system are known to the author. The obvious success of the system in terms of continuous high enrollments and course offerings over the past 15 years may explain the lack of formal evaluation studies. However two studies have been done of one-to-one telephone tutoring at the Universities of Lund [77] and Linkoping [78] in Sweden. In both these studies a large majority of the students reported the telephone component to be helpful and to increase understanding of the coursework. Some of the problems previously discussed as characteristic of radio are common to telephone usage, as are their solution. Use of the telephone for teaching requires that tutors be sensitive to such problems as:

student shyness (strange people, no visual clues, poor emotional cues) [79]

lack of student skill in using a telephone - reluctance to use the telephone; [80]

timetabling telephone contacts [80]

tutor behaviour and personality traits, particularly verbal mannerisms [80]

the need for tutors to utilize or develop a range of interpersonal skills to establish rapport and identity between himself and participants. [81]

Fortunately, there is a growing awareness of the interpersonal problems inherent in teleconferencing and the area is becoming increasingly exposed to review. [82]

TELEPHONE LINKS TO DATA SYSTEMS

Data base networking is still predominantly by terrestrial cable and microwave link although intercontinental systems are becoming increasingly dependent upon satellite links. Several proposals have been advanced in recent years for large CBE networks; the Edunet system in the United States, [83] the Edinburgh Multiple Access Project, [84] and the Korean Educational Computer Network [85] and the Texas Telecomputer Grid already mentioned. [86] All these systems, but for the latter two, have not been developed past the initial stage due to a a number of factors including costs and system design problems. Less ambitious systems seem to have survived however. In New York city for instance students have dial access to a computer bank of mathematics drills; 2000 students can be catered for simultaneously. In Tokyo a system called DIALS has been developed (Dendenkoska Immediate Arithmetic and Library Calculation System). Using a removable overlay on a pushbutton telephone, a student can perform three types on calculation on this system; direct calculation, calculation using stored expression and calculation by library programs. [87] Probably the best example of a distance education computer network is that of the

British Open University. The central computing facility has a large number of remote terminals located so that 95 per cent of the student population are within eight kilometres of a terminal.[88] CAI programs are thus accessible to a large number of students. It would also be possible as an alternative to such fixed point terminals, to rent portable terminals to students to use at home by utilizing an acoustic coupler connected to the home telephone, which would use the telephone line to link into the central computer. The cost however would greatly exceed the fixed point system, especially where large numbers of students are involved.

STAND ALONE SYSTEMS

Before I continue I would like to briefly mention two stand alone systems which may have outstanding applicability to distance education; the intelligent videodisc and the Open University's Cyclops system.

The video disc is basically a new form of disc (like the current L.P. record) one version of which is read by a small laser beam. The disc is microscopically pitted to form the pattern for whatever is being recorded. The information is picked up by the laser and a complex of optic circuitry. The disc also has synchronizing pulses (for tracking control) and space for audio channels. Another version uses an electrically 'charged' disc read by a cartridge which measures the variation in capacitance caused by the pits in the disc and translates these into the signal. An intelligent video disk player has a microprocessor attached which allows programs on discs to simulate interaction by testing the student, correcting responses, replaying appropriate program segments and recording learning performance. Trialling such systems has been taking place in the United States in recent years. The biggest question on use of the systems, as usual, appears to be cost. Australia cannot expect videodisc technology until 1983 - 1985. One advantage of this should be a lower initial cost than was the case in European and American markets.

Cyclops [90] is a machine which at the lowest level plays audio/visual programs onto a television screen using a normal audio-cassette and tape recorder (see the diagram opposite). At its most complex, Cyclops can become an interactive system linked by telephone line to the institution. In this mode Cyclops has not only an audio/visual tape component, but an electronic blackboard (with student and lecturer using light pens) and a visual display unit (by telephone link to a central computer) provided by the television screen. The Cyclops box which attaches to the television set in the same manner as a television game and which may be connected to the telephone system, is composed of:

a stereo tape recorder;
a micro processor;
light pen;

telephone connection facility;

keyboard connection facility.

This system is currently being redeveloped to provide colour graphics. It is hoped that large trialling of the system will provide more information on its potential in the near future.

THE AUSTRALIAN CONTEXT

As was stated in the introduction, by 1990 the Australian terrestrial telecommunications network will provide access to the national system for all but 0.3 per cent of our population. This goal will be achieved by the completion of current extensions to the microwave network and the use of Digital Radio Concentrator Systems (DRCS) in remote areas. The map opposite gives an overview of the present network and the remote areas within which Telecom will expand its facilities over the next 10 years. The 1980 population of these remote areas is about 44,000 people distributed over some 1300 locations, from single homesteads to communities of up to 1000 people. By 1990 it is estimated that at current population levels only 300 people at less than 100 locations will not be able to access the national telecommunications system. This means that by 1990 the potential education market, at all education levels will be almost 100 per cent of the population, and that this market will have substantial access to telecommunications facilities. Within the same period it can be expected that the current expansion of radio and television services and the possible introduction of cable television services will be consolidated. The only discouraging cloud on the horizon is the possible continuation of the current funding policies in education which, based on present practices, would be unwilling to underwrite the extensive use of telecommunications facilities by education authorities. The problems inherent in the area were succinctly summarized in 1975 by the report *Telecom 2000*:

> *This study concludes that while there is a high long term potential for telecommunications in education, the rate of development will be constrained by resolution of basic issues about educational aims and goals, institutional problems and lack of agreement on curricular and other standards.*[91]

With the exceptions of present limitations on the expansion of broadcast television and AM radio, and the absence of cable television, all the telecommunications practices already discussed are possible within Australia now. By 1990 current policy initiatives indicate that there will be few, if any, limitations to the possible educational uses of the telecommunications network. A list of possible applications is given below, categorized by degree of interaction. The list includes hard copy communication components as well as media and telecommunications services.

Delayed/Non-Interactive Systems:

High quality print systems;
static graphics systems - slides, photographic prints, maps, posters, process charts, plans, etc;
materials packages for concrete and experiential learning situations;
passive audio-tape based systems;
passive video-tape/'Cyclops'-type systems;
passive video-disc systems;
facsimile transmission;
broadcast radio e.g. institutionally controlled FM radio for regional educational broadcasting;
broadcast television;
teletext systems;
data bases - e.g. regional and central libraries/resource centres, mobile library services;
computer based correction systems.

Simulated Interactive Systems:

Interactive video-disc systems;
computer-based programmed learning;

interactive programmed learning situations; audio-tape, 'Cyclops'; or print based;
gaming/simulated learning experiences.
view data systems.
two-way cable television.

Interactive Systems:

Mediated:

telephone - single calls, conference calls, INWATS;
two-way radio;
one-way video - 2 way audio systems.
viewdata systems.

Increasingly, Australian educators must give serious thought to the exploitation of these technologies, particularly at the higher education level where the distance education market over the next thirty years promises to be a large and demanding sector.

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